

In can be appreciated from the foregoing that the present door assembly, therefore, provides the appearance of a stile and rail door without the expense associated with conventional solid stile and rail doors and with the ease of construction as a hollow panel door. These and other objects, advantages, purposes, and features of the invention will become more apparent from the study of the following description taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is an elevation face view of a single panel style door assembly of the present invention;

FIG. 1B is an elevation face view of a two-panel style door assembly of the present invention;

FIG. 1C is an elevation face view of another embodiment of the door assembly of FIG. 1B;

FIG. 1D is an elevation face view of a three-panel style door assembly of the present invention;

FIG. 2 is an enlarged fragmentary elevation view of the door assembly illustrated in FIG. 1B;

FIG. 3 is a partial fragmentary view of one stile of the door assembly of FIG. 2;

FIG. 4 is a fragmentary view of a rail of the door assembly of FIG. 2;

FIG. 5 is a fragmentary view of an alternate embodiment of a top rail, such as the top rail of the door assembly in FIG. 1C;

FIG. 6 is an enlarged partial fragmentary view of the door assembly of the present invention illustrating the connection between the bottom rail and the left side stile of the door assembly of FIG. 2;

FIG. 7 is an exploded partial perspective view illustrating the connection between the bottom rail and the left side stile of the door assembly of FIG. 2;

FIG. 8 is a perspective view of an intermediate panel of the door assembly of FIG. 2 illustrating two panels assembled, such as by gluing to form a thicker panel;

FIG. 9 is a perspective view of another embodiment of an intermediate door panel of the door assembly of the present invention illustrating two panels assembled with a foam substrate to form a thicker panel;

FIG. 10 is a fragmentary elevation view of yet another embodiment of a door assembly of the present invention; and

FIG. 11 is an exploded enlarged perspective fragmentary view another method of assembling a door assembly of the present invention illustrating top or bottom slide-in panels.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1A-1D, the numerals 10, 110, 210, and 310, respectively, designate various styles of the stile and rail door assembly of the present invention. Door assemblies 10, 110, 210, and 310 are assembled from similar components and in a manner to create the appearance of a "stile and rail" door. The doors are assembled using a combination of stile and rail door construction techniques and hollow door construction techniques to minimize the cost and weight of the door but without sacrificing the appearance of the door. As will be appreciated from the description which follows, the door assemblies of the present invention may be assembled with two or more stiles and two or more rails to create a desired panel effect of a traditional stile and rail door. For ease of description, initial reference will be made herein to door assembly 110, which forms a two-panel style door, though it should be understood that three, four, five, and six-panel style doors may be constructed using similar techniques and similar components.

Referring to FIG. 2, door assembly 110 is assembled from a pair of generally vertical members or stiles 112 and 114 and upper intermediate and lower generally horizontal members or rails 116, 118, and 120. In preferred form, stiles 112 and 114 and rails 116, 118, and 120 are each similarly constructed from sub-frames and door skins, with the rails interconnected with the stiles using fasteners, such as wood dowels (142, 150).

Referring to FIG. 3, each stile 112, 114 is assembled from a sub-frame 122 and a pair of door skins 124 and 126, which are mounted to the front and back sides of frame 122 to create a hollow core 129 and, further, to create the appearance of forming a solid wood stile. Sub-frame 122 is formed from spaced apart generally vertical frame members 128 and 130, which are interconnected by vertically spaced frame members 132 and 134. Sub-frame members 128, 130, 132, and 134 may be formed from solid wood or wood MDF members and are interconnected by glue and/or fasteners, such as dowels, nails, or the like. It should be understood that the members may be interconnected by a combination of glue and fasteners and, further, that the number of fasteners may vary depending on the application.

Door skins 124 and 126 are mounted over sub-frame 122 and attached thereto by, for example, an adhesive. Door skins 124 and 126, for example may comprise wood veneer panels, such as a wood cross-band, oak, birch, cherry, maple or the like, or may comprise a veneer over a substrate, such as MDF, or the like, and preferably have thicknesses in a range of about 1/2 inch to 1/32 inch and, more typically, in range of about 1/4 inch to 1/8 inch and, most typically, about 1/8 inch.

As best seen in FIG. 4, upper, intermediate and lower rails 116, 118, and 120 are similarly formed from a sub-frame 136 and a pair of door skins 138 and 140 which are mounted over sub-frame 136 and attached thereto by an adhesive or the like, which are similar to skins 124 and 126. Sub-frame 136 is similarly formed from a pair of horizontally spaced generally vertical frame members 142 and 144 and a pair of vertically spaced generally horizontal frame members 146 and 148. Frame members 142, 144, 146, and 148 are similarly interconnected by glue, nails, dowels or other suitable fastening methods. In the illustrated embodiment, intermediate and lower rails 118 and 120 have a greater height dimension than upper rail 116; however, it may be appreciated that all the rails may have different heights or rails 116, 118, 120 may have commensurate heights.

Referring again to FIG. 2, as noted above rails 116, 118, and 120 are interconnected with the generally vertical frame members 128 and 130 of the respective stiles, for example, by fasteners, such as dowels 150, which are inserted into mounting openings formed in the respective vertical frame members of the stiles 112 and 114 and vertical frame members 142, 140 of the respective rails. The number of dowels may be varied depending the height of the rails.

Referring to FIGS. 6 and 7, the inwardly facing side 130a of vertical frame member 130 of the respective stile includes a longitudinal groove 158 formed therein for receiving a corresponding projecting rib or flange 160 formed on the respective horizontal rail and, further, for receiving an intermediate door panel 162. Similarly, the inwardly facing sides 146a and 148a of frame members 146 and 148 of the horizontal rails similarly include elongated grooves for receiving the lower and upper edges 166a and 166b of panel 162. Though illustrated in reference to the left stile and lower rail, it should be understood that a similar construction is used between intermediate panel 162 and stile 114 and rails 118 and, further, between an upper intermediate panel 168 and stiles 112, 114 and rails 116 and 118. In this manner, when assembled, door 110 has the appearance of a two-panel stile and rail door assembly is assembled using hollow panel door components. Preferably, the elongated

grooves formed in the inwardly facing frame members of the respective stiles and rails have an adhesive applied thereto before the insertion of the respective intermediate door panel to thereby secure the door panel in the respective stiles and rails. Furthermore, though illustrated with a "square sticking pattern"; other patterns, such as rounded patterns, including a quarter round, oval or the like, may be used. It should be understood that additional trim may be provided at the juncture of the intermediate door panels and the stiles or rails to provide further detailing to the door though this additional detail is not illustrated herein.

To increase the support for the door skins, door assembly 110 may include inserts, such as corrugated or honeycomb paper or cardboard inserts or foam, which are placed in between the door skins. The number, size and type of insert may be varied. Typically any suitable light weight material may be used. In addition, should a heavier door be desired, a more dense insert may be used, such as particle board or the like.

In addition, to provide local support to stiles 112, 114, for mounting hinges or door handles or locks, door assembly 110 may include blocks 180, such as wood blocks, which provide a mounting surface for the mounting hardware or lock set, which usually requires a bore to be machined through the door.

Referring to FIG. 5, it should be understood that the rails and also the stiles may be formed from non-rectilinear frame members, for example, to create an arch or the like. As best seen in FIG. 5, the upper rail 116' is formed from space apart generally vertical frame members 140', 142' and upper and lower generally horizontal frame members 146' and 148', with frame member 148' machined or formed with a lower edge 148a' forming an arch.

It should be understood, that the other rails may be provided with frame members that also include an arched edge, such as shown in FIGS. 1A and 1C, to create yet a different style of door.

Referring to FIGS. 8 and 9, the intermediate door panels 162 and 168 are each formed from a pair of door skins 170 and 172, which are co-joined, for example by an adhesive. Typically, door skins 170 and 172 have an $1/8^{\text{th}}$ inch thickness to form an overall intermediate panel thickness of approximately $1/4$ of an inch. The door skins may be formed from a wood veneers or from an MDF cross band (in which a very thin veneer, for example on the order of less than $1/80^{\text{th}}$ of an inch, may be applied over the MDF) to give the appearance of a wood panel. Similarly, the door skins applied to the frames of the respective stiles and rails may be similarly formed from an MDF cross band to further reduce the cost of

the door assembly. Further, while panels 162 and 168 are illustrated as flat panels, panels 162 and 168 may comprise raised panels, double hip panel, grooved panels, or panels with glass inserts. In addition, the panels may be pre-finished, with either a primer coated for painted doors or with a stain and polyurethane finish for example for wood doors. The doors skins forming the stiles and rails may be similar pre-finished.

Referring to FIG. 9, the thickness of the intermediate door panels may be increased to, for example, in a range of $\frac{3}{4}$ inch to $\frac{1}{2}$ inch and may be formed from a combination of wood door skins and a layer of insulation 174', such as a foam core 174', which is sandwiched between door skins 170' and 172'. Similarly, the door skins may be formed from wood veneers or MDF cross band (with wood veneers on the order of less than $\frac{1}{80}$ th of an inch) to thereby further reduce the cost of the door. When a layer of insulation is added to panels 162 and 168, the insulation may provide increased damping and reduce the risk of the panels vibrating or rattling.

Referring to FIG. 10, the numeral 410 designates another embodiment of the door assembly of the present invention. Door assembly 410 is similarly constructed from a plurality of stiles 412, 414, and a plurality of rails 416, 418, and 420 and upper and lower intermediate door panels 462 and 468. Stile 412 is formed from generally horizontal vertical frame members 428 and 430 that are interconnected by upper and lower frame members 432 and 434, which span door 410 to form upper and lower rails 416 and 420 and, further, to interconnect the respective generally vertical frame members 430 and 428 of rail 414.

Rails 416 and 420 are formed by frame members 432 and 434, respectively, and, further, by horizontal frame members 448 and 450, which interconnect with generally vertical frame members 430 of stiles 412 and 414, for example by glue, nails, or other suitable fasteners. Intermediate rail 418 is constructed from a pair of generally horizontal frame members 452 and 454, which span between frame members 430 and 430 of stiles 412 and 414 and, further, are interconnected therewith, for example, by glue, which extend into the vertical frame members 430 of the respective stiles. It should be understood that other methods of attachment may also be used.

To provide additional support to the vertical frame members of stiles 412 and 414, each stile 412, 414 preferably includes a block 456, which may optionally provide a mounting surface for the horizontal members 452 and 454 of rail 418. Furthermore, blocks 456 provide a mounting surface for the respective door hardware, such as door latches or the like. As will be understood from FIG. 10, the respective stiles and rails include door skins

that are adhered to the respective frame members forming the respective stiles and rails similar to the previous embodiments and, further, may include inserts, such as inserts 460, which provide support to the respective door skins, without the additional weight associated with solid wood constructed doors.

5 Referring to FIG. 11, another method of constructing a door assembly of the present invention includes providing a flat panel door assembly 510, which is formed from a perimeter frame 512, and cutting an opening 514, such as a central opening, in the door assembly. The opening is framed by a wood frame support 516 with a groove 518 formed therein along the frame's vertical edges 520 (only one shown) and horizontal edge 522 for
10 receiving an intermediate panel 562, similar to the intermediate panels described in reference to the previous embodiments. The lower member 524 of frame 512 is formed with a transverse opening 526 for inserting intermediate panel 562 into the door and into grooves 518. Alternately, the intermediate panel may be inserted from the top member (not shown) of the frame 512. Where upper and lower intermediate panels are to be formed, the respective
15 panels may be inserted from both ends of the door.

It should be understood from the foregoing, that the door of the present invention may be formed from wood veneers and may be pre-finished or may be formed from materials suitable for painting. Furthermore, the components forming the door may be stained, pre-finished, or primed before assembly. In the latter embodiment, the construction
20 of the door eliminates the gaps that are associated with a stile and rail door, which is especially important when using a painted or primed finish. Furthermore, it should be appreciated that other sizes of doors may be formed using the method of the present invention. Furthermore, although described in reference to the 36 inch width door example, the door of the present invention may be assembled into various shapes and sizes without
25 departing from the scope of the invention.

For example, for a 36 inch door, such as a birch door, the door may be constructed of two hollow core birch flush door panels that are manufactured so that they are 5 inches wide and 80 inches tall with a 1-3/8 inch thickness, for example. A top rail will be formed from a 5 inch by 27 inch long hollow core flush door assembly again with a 1-3/8
30 inch thickness. A bottom rail will be similarly manufactured from a 12 inch wide and a 27 inch long hollow core flush panel door assembly with a 1-3/8 inch thickness. These stiles and rails will be trimmed and machined, with dowel holes drilled into the inwardly facing sides of the respective frame members of the rails and stiles. Furthermore, a groove, such as

a ¼ or ½ inch groove, will be machined into the inwardly facing edges of the respective hollow door panels. Two birch plywood veneers will be glued back to back and formed into a panel, such as a ¼ inch or greater panel. The wood dowels will then be placed into the dowel holes of the stiles and rails. The birch panel will then be cut to size and fitted into the
5 grooves cut into the stiles and rails, with the four stiles and rails clamped together and with the wood dowels extending into the respective dowel holes. It should be understood that other door thicknesses may be produced using the same method and, further, doors with different veneer thicknesses and interior panel thicknesses may be used. In addition, the width of the respective stiles and height of the respective rails may be adjusted to suit. It
10 should be understood from the foregoing that the door assembly of the present invention may be constructed to form a single panel door style, such as shown in FIG. 1A, or multiple panel door styles, such as illustrated in FIGS. 1B-1D, including door assemblies that incorporate more than two stiles.

It can be appreciated that the method of manufacturing or assembling the door
15 assembly of the present invention combines hollow core flush door assembly construction with stile and rail door construction to produce an authentic looking stile and rail door without the normal high expense associated with solid wood door construction.

While several forms of the invention have been shown and described, other forms will now be apparent to those skilled in the art. Therefore, it will be understood that
20 the embodiments shown in the drawings and described above are merely for illustrative purposes, and are not intended to limit the scope of the invention, which is defined by the claims, which follow as interpreted under the principles of patent law including the doctrine of equivalents.